COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-163074

Dear Mr. Chairman:

This is in response to the House Committee on Appropria-
tions' request, contained in House Report 92-666, dated Novem-
ber 11, 1971, that the General Accounting Office review the
system engineering study of the Army's Tactical Operations
System (TOS) Operable Segment. In that report and in subse-
quent discussions with your office, we were informed that you
were particularly interested in the following matters: (1)
the interoperability aspect of TOS, (2) the compatibility as-
pect of TOS, (3) the development of software for the TOS Op-
erable Segment, (4) the adoption of a standard data language
by the Army, (5) work-load simulation, and (6) the Army's
justification for a proposed sole-source award in procuring
the TOS Operable Segment.

BACKGROUND

TOS is an automatic data processing system that the Army
is developing which will provide for automatic processing and
storage of input data and automatic retrieval and display of
information necessary for timely decisions in the areas of
operations, intelligence, and fire-support coordination.

As the first step in an incremental development of TOS, a
system engineering study made by the Army from July to Decem-
ber 1971 developed specifications for a test bed which would
use a segment of a division-level system called the TOS Oper-
able Segment. The TOS Operable Segment is an austere milita-
rized system that the Army proposes to buy consisting of one
division central computer center, one division remote computer
center, one brigade remote computer center, two group display
devices, 19 message input-output devices, 18 message input
devices, a software support system, and some equipment for a
teleprocessing design center. In the TOS Operable Segment,
the data processing of three functions--enemy situation,
friendly unit information, and Army air operations--will be
automated. The TOS Operable Segment will be used to (1)
test the feasibility of using general-purpose militarized
equipment for TOS, (2) validate the TOS concept, (3) refine
user requirements, (4) provide empirical data to support

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cost-effectiveness analyses, and (5) aid in the determination of interoperability requirements between TOS and other systems.

Other Army tactical data systems that TOS will relate to are (1) the Tactical Fire Direction System (TACFIRE), a system being developed to improve the effectiveness of field artillery support, (2) the Combat Service Support System (CS3), a system designed to automate the recordkeeping for such functions as supply, personnel, and material readiness, (3) the Air Defense Command, Control, and Coordination System (AN/TSQ-73), a system being developed to supervise and control the engagement operations of surface-to-air missile battalions, to provide protection to friendly aircraft, and to disseminate long-range radar and air battle data, (4) the Air Traffic Management Automation Center, a system being developed as the automated part of the Army's Air Traffic Management System, and (5) the Army Security Agency Tactical Support System, a system composed of automated elements of the Army Security Agency's tactical system.

INTEROPERABILITY

We were requested to determine whether (1) TOS would be interoperable with other systems, especially TACFIRE and CS3, (2) TOS Operable Segment software would be interoperable with other systems, and (3) the development of nonstandard and nontransferable software would create a major problem with respect to interoperability.

Finding

According to the military services, interoperability is the ability of tactical data systems to (1) exchange data in a prescribed format and frequency with mutual noninterference and (2) process such data through hardware, software, and procedures to extract intelligible information which is identical or differs only by an established set of constants.

The Army envisions TOS as being interoperable with other tactical data systems; however, the extent of real-time interoperability has not been determined. Tentative real-time interoperability requirements have been identified for echelons at the

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division level and below and are currently being identified for corps and field-army levels. The Army categorizes its real-time interoperability requirements as either essential (necessary for the functional operation of the recipient system) or desirable (those which assist, improve, or permit full exploitation of the recipient system). In the study of TOS requirements for real-time interoperability with any of the other systems at the division level and below, none were considered essential; however, it was considered desirable that TOS have real-time interoperability with other systems, including TACFIRE and CS3. These requirements are currently being analyzed to determine the feasibility and costs involved in implementing them. Army officials have stated that firm real-time interoperability requirements for TOS will not be established until November 1972.

We were advised that standard and transferable software per se would have no impact on interoperability but that it would allow systems being developed to use some of that existing software and thus to eliminate some development and maintenance costs. Army officials advised us that the software being developed for the TOS Operable Segment would be transferable to another computer through the use of the Tactical Procedure Oriented Language (TACPOL)--which was developed for TACFIRE and which is to be used as the standard higher order language (see p. 4)--and a TACPOL compiler.

COMPATIBILITY

We were requested to determine whether the TOS hardware and software would be compatible with other Army systems.

Finding

According to the military services, systems are compatible when necessary information can be exchanged at appropriate levels of command directly and in usable form. Tactical communications equipments are compatible if they can exchange signals without the addition of buffering, translative, or

similar devices for the specific purpose of achieving work-
able interface connections and if the equipments or systems
being interconnected possess comparable performance character-
istics, including suppression of undesired radiation.

The hardware for TOS (as opposed to the hardware for the
TOS Operable Segment), all functional applications of TOS, and
the ultimate echelons to use TOS have not been definitely de-
termined. Thus the compatibility of the TOS hardware and soft-
ware with other Army tactical data systems cannot be assessed
by the Army at this time.

SOFTWARE

The Committee report stated that the Army should consider
(1) competition in the purchase of the hardware and (2) develop-
ment of the software required for the TOS Operable Segment with
its own work force. The Committee was also interested in learn-
ing what technical assistance would be provided in developing
the TOS Operable Segment software.

Finding

The Army proposes to award a sole-source, cost-plus-
incentive-fee contract to Litton Systems, Inc., for the hard-
ware for the TOS Operable Segment (see p. 6) and on May 25,
1971, instructed the U.S. Army Computer Systems Command
(USACSC) to develop the software for the TOS Operable Segment.
USACSC officials have stated that outside technical assistance
will not be required in developing the TOS Operable Segment
software; however, the Project Manager, Army Tactical Data Sys-
tems, has stated that a small amount (1 to 2 man-years) of
assistance in defining the hardware-software interface may be
required from Litton (the developer of the TACFIRE computer)
and is including this requirement in the solicitation.

STANDARD LANGUAGE

We were asked to determine whether the TACFIRE lan-
guage would be the standard language and, if so, how it

would interoperate with other Army systems, specifically CS3.

Finding

During the development of TACFIRE, the Army decided to adapt from existing sources a derivative computer language to serve as the standard higher order language for future tactical data systems. The Army is now making a study to validate and determine the suitability of this language (TACPOL) for future tactical data systems. The Army plans to use TACPOL for the TOS Operable Segment and thus to capitalize on the use of certain TACFIRE software, such as the compiler, operating system, and the maintenance and diagnostic routines. Army officials advised us that the use of a standard language, such as TACPOL, would have no impact on interoperability.

WORK-LOAD SIMULATION

The Committee report stated that current and projected work loads should be simulated and documented.

Finding

The system engineering study report indicates that a simulation team modeled the hardware and software configurations postulated by the system engineering study and simulated the operation of these configurations in the expected field environments. Simulation demonstrated that the system would handle the normal and peak loads of the TOS Operable Segment (a peak load is defined as 20 percent of the 24-hour load being experienced in 1 hour) and the normal load of a full division. Simulation of the full division peak load may saturate the system; however, this overload can be compensated for by blocking low priority users, programs, and files from use. The report also points out that it is somewhat unrealistic to assume that all the division subscribers would experience a peak demand at the same time and for all functional areas. Documentation of the work-load simulation is contained in the system engineering study.

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SOLE-SOURCE PROCUREMENT

In its report the Committee questioned the use of sole-source contracting for system equipment and software development. It expressed an interest in determining how the Army justified its sole-source action, whether it looked very closely at other manufacturers' capabilities, and whether the criteria used by the Army were valid.

Finding

The proposed sole-source award is primarily for the procurement of hardware. The hardware and software developed under the TACFIRE program are to be used to the maximum extent possible, and additional software is to be developed by Computer Systems Command. (See p. 4.)

Representatives of the Army advised us that commonality resulting from using the same equipment for both TOS and TACFIRE would be a significant advantage over using different equipment for TOS by reducing the number of different parts needed in inventory, reducing maintenance problems, and making training easier. Of the 17 components in the TACFIRE system, 12 may be used without modification in the TOS Operable Segment, four will require modification, and only one will have to be replaced. The Army representatives advised us also that, by using the Litton equipment, a great deal of the TACFIRE software already available could be used on the TOS Operable Segment. According to the Army representatives the sole-source award to Litton for the TOS Operable Segment had the further advantage of reducing the technical risk associated with adoption of another system and of also enabling the system to be fielded as early as possible at the least cost.

Army representatives indicated that these advantages of the Litton equipment justified the contemplated sole-source award.

In the system engineering study an evaluation was made of potential industrial sources for the TOS Operable Segment in

terms of cost, time schedules, technical risk, and contractor competence. During the study various contractors gave presentations of their computer and system capabilities. The study group did not obtain written proposals from potential suppliers other than Litton, because its instructions from the Army were to look to other contractors only in the event that the TACFIRE equipment could not be used. By mid-September 1971 the study group had decided that only Litton could meet Army guidance criteria for early fielding of a TOS Operable Segment and use of already developed militarized equipment.

In an industry evaluation dated March 1972, the Army stated that the criteria used in assessing the contractors had been cost, time schedules, technical risk, and competence. The Army found that all the contractors interested in the TOS Operable Segment, given sufficient time and money, could design and develop a militarized TOS Operable Segment. The study group did not quantify the increased time, cost, and technical risk associated with procurement of the TOS Operable Segment equipment from sources other than Litton. According to the Army, each potential supplier would have to undergo major design and development tasks and it was obvious to the study group that, on the basis of its knowledge of the complexity of the design and time required, none of the potential suppliers could compete with Litton and that therefore quantification was not considered necessary.

To further evaluate whether the Army adequately considered other manufacturers' capabilities, we selected a sample of three potential suppliers from the computer industry and discussed with them their (1) interest in competing for the TOS Operable Segment award, (2) capability to meet the requirement, (3) proposed system cost, and (4) estimate of time required from contract award to delivery.

Each of the potential suppliers contacted expressed an interest in competing for the award and stated that it had given briefings of its system approach to TOS to representatives of the study group. Each potential supplier stated that it had a central processing unit and either possessed, or

could obtain, the peripheral equipment to meet the TOS require-
ment. Two of the three potential suppliers stated that they
had produced, or were producing, similar systems either for
other military services or for foreign governments. Two of
the potential suppliers furnished us with cost data, and they
were generally in the same range as the Army's estimated data
for the procurement from Litton. The times required to de-
liver equipment for a TOS Operable Segment ranged from 6 to
24 months. One of the potential suppliers has stated that a
technique available on its equipment makes it technically
feasible to transfer any part of the previously written TOS
or TACFIRE software programs to suitable militarized com-
puters.

Army officials informed us that, after receiving brief-
ings from other potential suppliers, the study group had con-
cluded that, although certain of these manufacturers did offer
central processing units and certain manufacturers did offer
some required peripherals, only Litton offered a complete mil-
itarized system (TACFIRE) which would meet the TOS Operable
Segment requirement.

According to Army officials negotiation of a competitive
contract at this point in time would result in (1) an abandon-
ment of the commonality concept, (2) possible loss of the soft-
ware development performed at the Computer Systems Command for
the TOS Operable Segment, (3) loss of program impetus and mo-
tivation, and (4) a delay of the program by at least 1 year
(because of the need to rewrite hardware specifications and
evaluate proposals from sources other than Litton) or up to
2 years or more if a contractor other than Litton was selected
(because of the need for additional development work).

CONCLUSION

The degree of urgency assigned to the requirement for
fielding the TOS Operable Segment is the key determinant in
justifying the proposed sole-source award.

With respect to urgency the Army stated that automation
of tactical command and control functions might increase its

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ability to exploit combat power. Any delay would threaten the security of the United States in that it would aggravate the inefficiency and lack of potential combat capability.

We found no basis in our review for questioning the Army's concept of urgency for fielding the TOS Operable Segment. We believe that, if the delay involved could have been tolerated, the Army should have obtained competitive proposals. If a lower price were bid by any other contractor, it would have provided a basis for evaluating the possible savings involved against the advantages claimed for the sole-source award; i.e., commonality of components, use of software development already performed, and continued program impetus and motivation.

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We did not obtain formal agency comments on the matters included in this report.

We plan to make no further distribution of this report unless copies are specifically requested, and then we shall make distribution only after your agreement has been obtained or public announcement has been made by you concerning the contents of the report.

If we can further assist you in this matter, please let us know.

Sincerely yours,

Comptroller General
of the United States

The Honorable George H. Mahon
Chairman, Committee on Appropriations
House of Representatives